

Chapter 12

Ophthalmologic Disorders

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I. DISEASES OF THE CORNEA

A. Corneal ulceration. Corneal ulcers are one of the most challenging therapeutic problems in equine medicine but present much less of a problem in food animals. Loss of vision is often disastrous to horses, which often have athletic performance expectations.

1. Patient profile and history. Corneal ulceration can occur in any animal regardless of age, breed, or sex. Of the large animals, horses with corneal ulcers are the most challenging to successfully treat. This chapter is directed to the equine, with the understanding that principles of diagnosis and treatment in the other large animal species can be similar.
2. Clinical findings. Animals with ulcerated corneas exhibit blepharospasm, epiphora, and often are photophobic. These animals also may appear head shy and reluctant to allow physical examination of the head region.
3. Etiology and pathogenesis. Ulcers result from mechanical injury (e.g., entropion in a foal) toxic, infectious, or chemical insults to the cornea, exposure (e.g., moribund septic foals), or decreased tear production. Corneal ulcers can heal without incident or rapidly progress to corneal perforation.
4. Diagnostic plan. Early diagnosis is invaluable for optimal success in treating equine corneal ulcers.
 - a. Fluorescein dye staining. Although some corneal ulcers present with an obviously visible breach in the normally clear uniform surface of the cornea, the eyes of animals with any signs of ocular pain (e.g., blepharospasm, lacrimation) should be stained with fluorescein dye to detect ulceration.
 - (1) Applying the stain often requires restraint in the form of a **twitch** or by chemical means.
 - (2) If damage to the cornea is only superficial, the site retains fluorescein only minimally, whereas complete loss of the epithelium results in the appearance of a focus of brilliant green at the ulcer site.
 - b. Cram stain and culture and sensitivity testing. While the animal is restrained, other diagnostic samples can be taken, including a corneal scraping for a Cram stain and a culture and sensitivity evaluation to assist in guiding treatment.
 - c. Staging. It is also useful in horses to **stage** the ulcer according to size, depth, and involvement of surrounding corneal tissue. This guides both how aggressive the treatment should be and the prognosis.
 - (1) Stage 0 is a healing or static superficial ulceration.
 - (2) Stage 1 is a superficial ulcer of one-third or less of the corneal thickness. The ulcer has distinct, healthy edges.
 - (3) Stage 2 ulcers are large or deep ulcers of more than one-third the corneal thickness with moderate to marked corneal edema. Inflammatory infiltrates and keratomalacia also may be present in animals with stage 2 ulcers.
 - (4) In stage 3 ulcers, corneal perforation is present or imminent.
5. Therapeutic plan
 - a. Pharmacologic therapy
 - (1) Although antibiotics may not be necessary in the most superficial of corneal ulcers (stage 0), they are usually incorporated in the treatment regimen and are essential in many cases because the site can readily become infected.
 - (a) Broad-spectrum antibiotics (e.g., the triple antibiotic combination of **baci**-tracin, neomycin, and **polymyxin B**) or products with gentamicin α

chloramphenicol (except in food animals for the latter) can be used every 4–6 hours.

- (b) Antifungal agents. Corneal ulceration sometimes may be **slow** to respond to treatment or may worsen despite apparently adequate treatment. In such cases, it is important to repeat scrapings and cultures of the ulcer because mycotic infection of the site may occur, particularly with the disruption of the balance of normal flora of the eye caused by concurrent treatment with broad-spectrum antibiotics. Most fungi can be readily seen by routine staining techniques. Specific **antifungal** drugs (e.g., miconazole, ketoconazole, natamycin) must then be used for ocular treatment.
- (c) Applying topical treatment. There may be difficulty applying topical medication because the horse resists treatment or the stage of the ulcer may necessitate treatment on an hourly or every second hour schedule. For these cases, it is preferable to use a continuous-flow subpalpebral lavage system so that medication is administered at a site away from the head through the lavage tube. For these systems, it is essential to factor in the volume of medication the tube holds to ensure that an appropriate amount of drug reaches the eye. Additionally, because a lavage system is usually left in place for up to several weeks, strict attention to sterile technique in handling the medication and to sterility of the injection port is essential.
- (2) Atropine is also a key treatment because of its invaluable cycloplegic and mydriatic effect, which decreases the pain of ciliary spasm and reduces synechia formation when given every 6–12 hours daily.
- (3) Other adjunct treatments include the installation of collagenase and protease inhibitors, such as acetylcysteine and disodium ethylenediamine tetraacetic acid, to reduce corneal destruction by microorganisms. Serum can also be used topically to provide some of the humoral defenses to this site.
- b. In addition to pharmacologic treatment, it is essential to remove any mechanical causes that predispose to ulcer formation (e.g., exposure and drying of the eye in an ill foal) or any other mechanical cause of the ulcer (e.g., foreign bodies in the conjunctiva, entropion).
- c. **Debridement** and surgery. If necrotic **tissue** is present in the ulcer, debridement of the ulcer edges can be performed using a cotton swab containing dilute povidone-iodine. However, this should not be performed if there is a **desmetocele**, which indicates that corneal perforation is imminent. In this case, surgery is indicated. Support for desmetoceles, or large ulcers, can be managed using a third eyelid flap or a conjunctival flap, the latter being preferred if there is danger of corneal perforation. The conjunctival tissue provides maximum direct support, a direct blood supply, and a source of fibrovascular tissue.
6. Prognosis. With early and appropriate treatment, many cases of corneal ulceration can be successfully managed. However, prognosis depends on several factors, including the rapidity of diagnosis and specific treatment, tractability of the animal, owner compliance, and the organisms involved.

B. Conjunctivitis

1. Keratoconjunctivitis

- a. Patient profile. Infected animals show signs of increased lacrimation, blepharospasm, and conjunctival **hyperemia**.
- b. Etiology. There are several causes of the disorder in large animals.
 - (1) In foals, keratoconjunctivitis can be associated with adenovirus infection.
 - (2) In older horses, the disorder can be associated with infections such as equine viral arteritis, equine herpesviruses, and with *Moraxella equi*.
 - (3) In sheep and goats, associated infections include *Chlamydia psittaci* in sheep and *Mycoplasma agalactia* in goats.
- c. Therapeutic plan. The infectious causes of keratoconjunctivitis are usually transient. Affected animals recover either without treatment or with the use of a short-

term ophthalmic antibiotic ointment. The exception to this is infectious bovine rhinotracheitis (IBK).

2. Infectious bovine keratoconjunctivitis (IBK)

- a. Patient profile and history. Also known as "pinkeye," this infectious ophthalmia is observed mostly in young animals and peaks in incidence from mid-June to mid-August, coinciding with fly season. Hereford cattle and their crosses are the most susceptible.
- b. Clinical findings
 - (1) Initial signs include serous lacrimation from one or both eyes, photophobia, and blepharospasm. The central part of the cornea usually becomes opaque from edema and cellular infiltrates, after which ulceration of the cornea is common.
 - (2) If untreated, some cases progress to corneal perforation with resulting painful panophthalmitis, glaucoma, and blindness. However, if corneal **neovascularization** reaches the ulcer before perforation, corneal healing quickly proceeds, although a permanent corneal scar can remain, appearing as a white or greyish opacity in the central cornea.
- c. Etiology, risk factors, and pathogenesis
 - (1) Etiology. This disease is caused by *Moraxella bovis*, which may exist in the nares of carrier host cattle and can be spread by vectors such as the face fly *Musca autumnalis*. In addition to insect **vectors**, the organism is transmitted by direct contact, aerosols, and **fomites**.
 - (2) Risk factors
 - (a) Development of the disease is enhanced by ultraviolet radiation damage to the cornea, which lowers the resistance of the cornea to colonization of *M. bovis*. This is probably the reason that cattle with pigmented nictitans and eyelids are more resistant to infection than nonpigmented cattle.
 - (b) Other predisposing **factors** include vitamin A deficiency or **mechanical** irritants to the eye (e.g., high dust or pollen counts, trauma from tall grass on pastures).
 - (3) Pathogenesis. The organism *M. bovis* has a **piliated** phase that is necessary for attachment, and the nonpiliated phase is apparently harmless. When the organism has begun growing on the cornea, a bacterial **cytotoxin** initiates corneal lesions, and deep ulcers follow as a result of the interaction between the host's immune system and the bacterium.
- d. Diagnostic plan and laboratory tests. Most cases of IBK are readily diagnosed by the appearance of blepharospasm and tearing associated with developing corneal opacity. Bacterial culture from a swab of the conjunctival sac aids in ruling out other systemic diseases such as infectious bovine rhinotracheitis (IBR) or bovine malignant catarrh (BMC) [see Chapter 6 II B 6 a, f], both of which can cause similar signs, though both eyes are usually equally affected in such cases, and systemic signs are also present.
- e. Therapeutic plan. In clinical situations, treatment only occurs when the cornea has already become ulcerated or shows **neovascularization**. Many cattle, however, heal on their own **before** corneal ulceration occurs. Therefore, the cost of treatment needs to be weighed by the client against the adverse implications of this disease, which include decreased growth and milk production and disfigurement of cattle resulting in decreased value of feeder calves. Also, the humane aspects of appropriate care for the animals should be considered.
 - (1) Treatment goals include ridding the eye of *M. bovis*, shortening recovery time, and preventing permanent damage to the eye.
 - (2) Local treatment
 - (a) Antibiotic. Therapy is usually effective with most of the commonly used antibiotics, the exceptions being cloxacillin, streptomycin, and tylosin. For convenience of administration, **mastitis** preparations often are used. Medication is instilled in the conjunctival sac every 8 hours (often less frequently by the client) for several days. Both eyes should be treated at the same time.

- (b) Cattle with ulcerated eyes also benefit from the instillation of 1% **atropine** ointment every 8 hours for 2–3 days to decrease the pain of ciliary spasm, but this is seldom incorporated into treatment.
- (c) Providing there is corneal neovascularization, a subconjunctival dose of penicillin G (1 ml) with dexamethasone (1 mg) can be highly effective in both treating the infection and hastening clinical recovery. This treatment can be repeated in 3 days if needed, but this should not be used in horses.
- (3) Systemic treatment. Other methods of treatment include placing eye patches over the ulcerated eye to protect it from exposure and the systemic administration of oxytetracycline (long acting). Systemic penicillin does not appear to be effective because it does not pass readily into lacrimal secretions.
- (4) Surgery. For deep corneal ulcer, a third eyelid flap may be considered, and where severe ulceration and globe rupture has occurred, enucleation may be necessary.
- f. Prevention
 - (1) Carrier animal reduction. Because *M. bovis* is thought to persist in a herd in the nasal cavities of carrier animals, prevention is possible by reducing the number of carrier animals. Two treatments with long-acting tetracyclines administered intramuscularly 72 hours apart reduces the severity of ocular infection and eliminates most carrier infections. Early aggressive treatment of clinically affected animals is important to reduce the spread of *M. bovis*.
 - (2) Vaccination. A vaccine that induces secretory antibody (immunoglobulin A) against the pili antigens is available and is reported to lower herd morbidity.
 - (3) Elimination of insect vectors. Another important component of preventing disease spread is to reduce number of insect vectors, such as the face fly, that can rapidly inoculate many cattle in the herd.
 - (a) Fly control measures should be initiated early in the season to prevent a buildup of fly populations. Manure should be stored and disposed of in such a manner as to minimize the sites for incubating fly larvae.
 - (b) Individual animal fly control can be managed with insecticide-containing ear tags or by placing dust bags with insecticide in traffic areas.

C. Ocular trauma

1. Patient profile and history. As in corneal ulcers, the signalment of animals with ocular trauma is highly variable. Blunt, nonpenetrating injuries to the globe are generally less alarming than penetrating or perforating injuries.
2. Clinical findings
 - a. Signs. Depending on the extent of the damage, signs of trauma vary from mild contusions and abrasions to severe globe perforations or protrusion of the third eyelid. Chemosis, blepharospasm, and epiphora follow as a consequence of the damage.
 - b. Stages. As in horses with corneal ulcers, the extent of trauma can be staged for purposes of treatment and prognosis.
 - (1) Stage 0 represents a minor injury with no corneal damage. Although there may be uveitis, there is no hyphema or damage to the posterior chamber.
 - (2) Stage 1 trauma has minor corneal damage, mild hyphema, and uveitis, but again there is no damage to the posterior chamber.
 - (3) A stage 2 injury is more extensive with severe, nonperforating, corneal damage, severe hyphema, and lens luxation or subluxation. Although the injury extends into the posterior chamber, there is neither retinal detachment nor ocular nerve damage.
 - (4) In stage 3, there is perforating ocular injury as well as retinal detachment and optic nerve damage. In these cases, saving the eye is unlikely no matter what the treatment.
3. Diagnostic plan
 - a. Diagnosis relies mainly on visual inspection of the eye along with evaluating all

visible structures with a bright light and an ophthalmoscope for lens and retinal appearances.

- b. Consensual pupillary response is used for assessing retinal optic nerve involvement. A miotic pupil in the affected eye carries a more favorable prognosis than a dilated pupil (a miotic pupil may still respond to light, whereas a dilated pupil does not).
- 4. Therapeutic plan
 - a. Lacerations. Large lid lacerations should be sutured to prevent excessive scarring or abnormal lid conformation, and the periorbital tissues should have cold compresses applied for the first 24 hours to reduce swelling.
 - (1) Conjunctival lacerations and subconjunctival hemorrhage usually heal readily by second intention.
 - (2) All corneal lacerations and perforations should be regarded as stage 2 or stage 3 emergencies. If the anterior chamber has not been entered, treat the eyes with topical antibiotics and cycloplegics as for a corneal ulcer. Healing is usually rapid and suturing not necessary. In more severe lacerations with penetration into the eye, there is a high risk of permanent damage, and these cases are best referred to a specialist.
 - b. Hyphema is treated with corticosteroids and mydriatics (see II A 5 a) because there is usually a concurrent iridocyclitis. However, if corneal ulceration has occurred, corticosteroids should not be used, and a nonsteroidal anti-inflammatory drug (NSAID), such as flunixin meglumine, can be administered. Stall confinement limits exercise and exposure to bright light. Topical antibiotics are indicated, and where penetrating wounds are present, systemic antibiotics will be needed. In hyphema that is unexplained or appears excessive in relation to the degree of trauma, clotting disorders should be ruled out.

II. DISEASES OF THE UVEAL TRACT AND OPTIC NERVE

- A. Periodic **ophthalmia** [equine **recurrent** uveitis (**ERU**), **moon blindness**]. Inflammation within the eye, called uveitis, can result in signs of tearing and blepharospasm without ulceration. Under this general heading of uveitis are anterior uveitis, which incorporates iridocyclitis (inflammation of iris and ciliary body); posterior uveitis, which involves chorioiditis with or without ciliary body involvement, endophthalmitis, or inflammation of the intraocular structures (i.e., uvea, retina, vitreous); and panophthalmitis, which includes all the above structures and the sclera.
- 1. Patient profile and history. Uveitis in large animals is most commonly seen in horses. ERU is the leading cause of blindness in horses. Horses with ERU have repeated bouts of ocular pain, which are usually manifested as severe blepharospasm, photophobia, and epiphora. Visual function may be impaired, particularly with ocular damage from repeated episodes.
- 2. Clinical findings. Examination of the eye reveals circumcorneal injection of blood vessels, conjunctival hyperemia, and corneal edema consistent with uveitis. Shining a bright light into the anterior chamber shows an aqueous flare, which is caused by cells or fibrin in the anterior chamber. The pupil is constricted (miotic), and there is often iridal congestion or neovascularization, which causes an apparent color and texture change to the iris.
 - a. Early in the acute stage, there is slight photophobia and epiphora. The eye will already be hypotonic (decreased intraocular pressure). Other ocular findings can include catarrhal conjunctivitis and vitreal haze.
 - b. After 2–3 days, hypopyon may be obvious with fibrin in the anterior chamber. A secondary interstitial keratitis (corneal edema) develops as well as conjunctival and circumcorneal congestion, and these precipitate and exude in anterior chamber. The eye is soft (hypotonic) and very painful to palpation. Photophobia,

miosis, and epiphora continue, and vision is impaired if there is bilateral involvement.

- c. If untreated, there may be permanent damage caused by cataracts, lens luxation, retinal damage, or phthisis bulbi.
 - d. Sequelae. Resolution of the ocular inflammation also results in the abatement of clinical signs of ocular pain. However, sequelae to repeated bouts of uveitis may be present. These include posterior and/or anterior synechia, corneal opacity, cloudy vitreous, cataracts, pigmented opacities on the anterior lens capsule (from posterior synechia that have broken loose from the lens), and atrophy or absence of corpora nigra. Fundoscopic examination is important because it may detect characteristic retinal lesions of peripapillary alar depigmentation and detachments or "butterfly lesions."
3. Etiology and pathogenesis
- a. Etiology. There are numerous possible causes of **ERU**. The initial stimulus for ocular inflammation can vary from infectious to immune mediated to traumatic, with infectious causes getting the most attention. However, an etiologic diagnosis is often not possible.
 - (1) **Various** microbial antigens have been implicated as the cause of **ERU** (e.g., leptospirosis, brucellosis, *Streptococcus*, equine influenza, *Toxoplasma*, *Chlamydia*, *Mycoplasma*). Infections caused by *Leptospira* species are most commonly associated with **ERU**.
 - (2) Microfilariae of the parasite *Onchocerca cervicalis* are also a factor in some cases of **ERU**. The dead or dying microfilaria become immunogenic, whereas the live filaria are often found in the horses with no inflammation.
 - b. Pathogenesis. When there is a host response to the antigens in the ocular structures, the inflammatory cells (e.g., eosinophils, PMNs, mononuclear cells) and various mediators of inflammation (particularly prostaglandins) alter vascular permeability and participate in ocular inflammation. The disrupted ciliary epithelium and altered vascular permeability allow leakage of protein and fibrin into the eye. This inflammation can be reactivated by the antigens or trauma. Vascular alterations with repeated episodes include endothelial hyperplasia, endothelial hypertrophy, and fibrosis. **Glaucoma** can occur secondarily to uveitis, but this is uncommon in large animals (see II B).
4. Diagnostic plan
- a. A history of previous ocular disease or injury is **often** available, which is sufficient to establish the diagnosis when combined with the typical signs of uveitis in the absence of ulceration.
 - b. Laboratory studies. Measurements of paired serum titers and aqueous titers to *Leptospira*, *Toxoplasma*, or *Brucella* species may help, with anterior chamber titers being higher than serum titers. If *Onchocerca* is involved, diagnosis can be aided by a biopsy of the **perilimbal** conjunctiva, in which microfilaria may be observed or the eosinophils found infiltrating the tissue.
5. Therapeutic plan. Early detection and treatment is important to prevent serious ocular sequelae. Specific systemic infections, such as leptospirosis, should be treated, but usually horses with **ERU** have no evidence of systemic illness.
- a. Atropine and corticosteroids. Atropine (administered every 2–4 hours at 0.5%–1% ointment or as a 3% solution) has mydriatic and **cycloplegic** effects. Relief of the ciliary spasm helps reduce ocular pain. In the absence of corneal ulceration, corticosteroids also are indicated to reduce the ocular inflammatory response. Topical treatment with both atropine and corticosteroids can be **attempted**, but the horse often is in too much pain to allow this; therefore, subconjunctival injections or a subpalpebral lavage system can be used.
 - b. Antiprostaglandins administered systemically (e.g., flunixin meglumine at 1.1 mg/kg every 24 hours intravenously, intramuscularly, or orally; phenylbutazone at 3–6 mg/kg orally or intravenously every 12 hours; aspirin 25 mg/kg orally every 12 hours) inhibit the release or activity of prostaglandins that are partially responsible for ocular inflammation.
 - c. Microfilaricidal treatment is indicated if the **ERU** is associated with **onchocerciasis** (e.g., diethylcarbamazine at 4.4–6.6 mg/kg daily for 21 days; levamisole at 11 mg/kg orally every 24 hours for 7 days; ivermectin at 0.2 mg/kg orally). This treatment is meant to reduce the "load" of antigen and kill microfilariae before they reach the eye. Because it is the dead microfilariae that elicit inflammatory response, anti-inflammatory drugs such as flunixin meglumine should be administered before parasiticide administration. Alternatively, it may be advisable to wait for the acute phase of **ERU** to subside before initiating parasiticide treatment.
6. Prevention. If the diagnosis of **ERU** is established, the client should be advised of the possibility of recurrence, unsoundness implications in the event of the future sale of affected horses, and the need for early treatment in future episodes to prevent serious sequelae.

- B.** Glaucoma rarely occurs in large animals but can occur secondary to structural changes associated with **ERU**, uveitis, trauma, or all of these conditions. This disorder may be more common than reported because ocular pressures are seldom examined in these species. If found, management should involve treating the underlying problem, such as in **ERU**. Chronic glaucoma may require enucleation and placement of an intraocular silicone prosthesis.

III. DISEASES OF THE ADNEXA

A. Equine **periocular** sarcoids

1. Patient profile. There is no breed, coat color, or sex predilection, but most affected horses are between the ages of 3 and 5 years.
2. Clinical findings. Sarcoids appear on other parts of the horse's skin but can be particularly troublesome as fleshy masses around the adnexa of the eye. They can be **verru-cous** with cauliflower edges or appear as smooth discrete nodules, or least commonly, a mixture of the two types. These are the most commonly reported tumor of horses.
3. Etiology and pathogenesis. The masses are fibroblastic and do not metastasize but are locally destructive with a high probability of recurrence. They appear to be of viral origin, with the viral particle similar or identical to the papilloma virus of cattle.
4. Diagnostic plan and laboratory tests. The history and clinical appearance of the masses are often typical. **However**, a biopsy with histopathologic examination is suggested, as other skin tumors can have a similar appearance. This rules out other types of tumors and habronemiasis.
5. Differential diagnoses. The main differential diagnoses for these masses around the eye are squamous cell carcinoma (see III D) and habronemiasis (see Chapter 17).
6. Therapeutic plan
 - a. Surgery. Successful treatment is rare. Surgical excision is only occasionally successful, with up to 50% recurrence rates, often within months. The periocular location of some sarcoids restricts excision because of possible compromise of eyelid function or disfigurement.
 - b. Surgical debulking with adjunct therapy is another option, but these adjunctive treatments (radiotherapy, cryotherapy, chemotherapy) are also met with limited success.
 - c. Immunotherapy appears to be the most effective method to treat periocular sarcoids.
 - (1) This treatment works by iatrogenic stimulation of the immune system for the horse to rid itself of the tumor and generally leaves no disfigurement or altered eyelid function. This form of treatment involves intrascleral injection of bacille **Calmette-Guérin** (BCG; attenuated *Mycobacterium bovis*), which stimulates phagocytic activity and induces a delayed-type hypersensitivity

response (cell mediated). The aim is to infiltrate the junction between the tumor and normally appearing tissue with the BCG. BCG is given every 2–3 weeks until the lesion regresses. It takes an average of four injections for cure; one horse was reported to take nine injections.

- (2) Side effects. Following injection, there is localized swelling, purulent discharge, and ulceration at the site. Because there is a risk of fatal anaphylaxis with repeated injections, pretreatment with flunixin meglumine and/or prednisolone (both 1 mg/kg) may be advised.

B. Ocular squamous cell carcinoma (SCC)

1. Patient profile and history. This tumor occurs most commonly in older Hereford cattle or crossbreds and peaks at ages 7–8 years. It is uncommon in cattle less than age 3 years. This disorder also occurs in high incidence in horses that are maintained at high altitudes and is most commonly found on the third eyelid.
2. Clinical findings include pink, irregularly shaped fleshy masses that occur on the eyelid, third eyelid, cornea, or conjunctiva. They are often ulcerated, particularly if located on the eyelid margin.
3. Etiology and pathogenesis
 - a. Etiology. Contributing factors are both genetic and environmental.
 - (1) Predisposition to the disease in Herefords is highly heritable, but ocular SCC is found in other breeds (i.e., Simmentals, Holsteins).
 - (2) Exposure to ultraviolet light appears to be a major causative factor. Therefore, risk factors include animals living at high altitudes and/or decreased latitudes where there is increased exposure to ultraviolet light. Reflection of light from snow, certain soil types, and irritation of eyes by wind, dust, and flies also are implicated as increasing the risk of ocular SCC development.
 - (3) Previous episodes of IBK are suspected as contributing to the formation of this tumor in cattle. Fewer than 10% of these masses on the eyes of cattle are carcinomas (malignant).
 - b. Pathogenesis. The lesions often start as a keratoacanthoma and hyperplastic plaques on the structures of the eye and proceed progressively to papillomas, then to squamous cell carcinomas. At this final stage, there is local invasion with or without metastasis.
 - c. Salvage. Cattle with extensive squamous cell carcinoma may be condemned for human consumption. The following antemortem and post mortem guidelines are used for determination of the disposal of the carcass.
 - (1) "Any animal found on antemortem inspection to be affected and the eye has been destroyed or obscured by neoplastic tissue and which shows extensive infection, suppuration, and necrosis, usually accompanied by foul odor, or any affected animal with cachexia, regardless of extent, shall be condemned.
 - (2) Carcasses of animals with the eye or orbital region affected will be condemned if the affection has:
 - (a) Involved the osseous structures of the head with extensive infection, suppuration, and necrosis
 - (b) Metastasized from the eye or orbital region to any lymph node (including the parotid lymph node), internal organs, muscles, skeleton, or other structure, regardless of the extent of the primary tumor
 - (c) Been associated with cachexia or evidence of absorption or secondary changes, regardless of the extent of the tumor
 - (3) Carcasses of animals affected to a lesser degree than described may be passed for human food after removal and condemnation of the head, including the tongue, provided the carcass is otherwise normal."
4. Therapeutic plan. There are variety of methods to treat these tumors, including surgical excision, cryosurgery, and hyperthermia.

- a. Surgical excision, involving removal of the mass or entire eye, can be performed under sedation and local anesthesia. In extensive cases the regional lymph nodes and salivary glands must also be removed. This is moderately successful and often used as a salvage procedure.
 - b. Cryosurgery is highly successful in animals with small (less than 2 cm in diameter) tumors. Freezing the tumor may achieve part of its success by increasing the tumor cell antigenicity so that any remaining tumor cells are destroyed by the body's own immunity. Cryosurgery equipment is commercially available. The initial cost of purchase is high but warranted if the practice area has a high prevalence of bovine SCC.
 - (1) This treatment involves a double freeze and thaw cycle using liquid nitrogen. The process requires a rapid freeze to -25°C , unaided thaw to 5°C , and rapid refreeze. Temperature probes in the tissue during the freeze cycle can ensure these criteria are met.
 - (2) This method has been reported to result in complete regression of 97% of tumors treated that were less than 2 cm diameter; whereas only 73% of those over 2 cm diameter regressed. During this procedure, other ocular structures need to be protected with a water-soluble lubricant and Styrofoam strips (a Styrofoam coffee cup makes a suitable and readily available shield).
 - c. Hyperthermia is also effective, easily performed, and an economic treatment for early forms of ocular SCC or large tumors that are surgically debulked before hyperthermia. The technique involves using a probe that emits a radiofrequency current to create moderate heat. Tissues are heated to 50°C , but the tissue penetration is only 4 mm. For treatment of appropriate sized tumors, this method has an 80% regression rate.
5. Prevention
 - a. Clients should be advised of the implication of breed predisposition in SCC. They are unlikely to decide to change breeds because of SCC, however, and so could try to breed for pigmentation around the eyes.
 - b. Far more important in managing this disease is early recognition and treatment of lesions when they are still small and circumscribed. These are often best screened for at the time of pregnancy testing or branding.

C. Entropion

1. Patient profile. This disorder can affect up to 80% of lambs between the ages of 1 week and 3 weeks. It is often bilateral and, if uncorrected, will result in ulceration and corneal vascularization.
2. Therapeutic plan. Treatment is to evert the eyelids, either using a simple stitch or staple in the skin of the eyelid or by injection of a bleb (0.5 ml) of antibiotic, usually procaine penicillin, in the lower eyelid. Even the trauma of the suturing process or the injection is often sufficient to evert the eyelid. Entropion also occurs commonly in weak, premature or ill foals secondarily to enophthalmos. It is found as a congenital abnormality in cattle, particularly in Herefords, and requires surgical correction to protect the cornea.

- D. Ectropion, or eversion of lower lid, can occur from overzealous correction of entropion or, rarely in foals, be a congenital abnormality.

IV. CONGENITAL OCULAR DISEASE. Although ocular abnormalities occur in up to 50% of stillborn calves, these disorders are far less common in live calves (2%–3% of births). A common abnormality is microphthalmos, which may be unilateral or bilateral and may have other associated abnormalities (e.g., cataracts). Most cases are sporadic and idiopathic, and although all breeds can be affected, this disorder is more common in Thoroughbreds. However, there is no proof that microphthalmos is an heritable trait, and in cattle, bovine viral diarrhea (BVD) and hypovitaminosis A are possible causes.

Other congenital ocular abnormalities include dermoids, blockage of nasolacrimal ducts, corneal, iris and lens, and retinal abnormalities.

- A.** Dermoids are focal masses that resemble skin affecting eyelid margin, palpebral and bulbar conjunctiva, nictitating membrane, and most commonly the cornea. This disorder can occur on any newborn but is more likely to be found in Herefords. Surgical removal is the treatment.
- B.** Congenital blockage of the nasolacrimal ducts appears as persistent epiphora from birth. Fluorescein dye can be instilled in the eye, and the lack of its subsequent appearance at the external nares establishes the absence of duct patency.
- C.** **Corneal abnormalities** are rare apart from dermoids but include microcornea, corneal melanosis, corneal opacities, and iridocorneal angle abnormalities.
- D.** Iris and ciliary body abnormalities are usually of little clinical significance.
 1. Heterochromia occurs particularly in light-colored horses, Holstein, Simmental, Limousine, and Angus cattle. Albinism is most likely to be seen in Herefords. Aniridia, bilateral absence of the iris, occurs as an autosomal recessive defect in Belgian horses. Structural defects in the iris (**coloboma**) may be hereditary in albino Herefords.
 2. **Lens** changes, such as cataracts, are a common congenital ocular defect in foals. Both eyes usually are affected, and they are associated with microphthalmia. The precise etiology is unknown, but suggestions include heredity, trauma (pre- or postnatal), poor nutrition, or in utero infections. There seem to be higher numbers of Arabian foals affected, but there is no proof of this being heritable. Progression of lens changes is unlikely, but if the cataracts are severe, they can interfere with vision.
 3. Retinal problems occur in horses, resulting in night blindness affecting mainly the Appaloosa but also other breeds to a lesser extent. Fundic examination is normal and the diagnosis is based on a history of reduced vision in low light. The disease can be confirmed with an **electroretinogram**. In cattle, retinal degeneration can be present at birth and has been linked to in utero bluetongue infection.

V. OCULAR MANIFESTATIONS OF SYSTEMIC DISEASES

- A.** **Exophthalmos.** Whether unilateral or bilateral, exophthalmos is a hallmark of orbital disease. Retrobulbar tumors (**lymphosarcoma**), chronic frontal sinusitis, or carcinomas of nasal cavities or sinuses are the main causes of exophthalmos.
- B.** Homer's syndrome. This syndrome consists of a combination of signs that include ocular changes of slight miosis, ptosis, and a slight enophthalmos. Other signs include ipsilateral facial warmth or sweating and, in cattle, a dry muzzle on the affected side. In older cattle, the cause can be a carcinoma in the nasal cavity, whereas in horses, the most likely cause of the signs is perivascular jugular injection, resulting in irritation to vagosympathetic trunk.
- C.** Other **manifestations**
 1. Eyelid abnormalities can reflect systemic disease, such as facial nerve palsy in **listeria**, which results in an **associated** ptosis and exposure keratitis. Also, "flashing" of the third eyelid to tactile stimuli is a classic sign in tetanus. With urticaria, there is bilateral edematous swelling of eyelids along with other **mucocutaneous-cutaneous** junctions.
 2. **Conjunctivitis** is particularly obvious in IBR and may be the only or the salient feature in some outbreaks. It is also a component of equine viral **arteritis** and **MCF**, the latter of which also results in corneal edema.

3. Changes in the uveal tract as a reflection of systemic disease are common in septicemia, where fibrin or pus (hypopyon) appears in the anterior chamber of one or both eyes. This is particularly common in colostrum-deprived calves.
4. Blindness results from a number of systemic diseases. Vitamin A deficiency causes blindness with dilated, nonresponsive pupils. This is caused by pressure on the optic nerve (noted by ophthalmoscope as papilledema) that occurs because of problems in the bony remodeling of optic canal.
5. Cortical blindness, blindness in the presence of light-responsive pupils, is a change that is associated mainly with polioencephalomalacia (thiamine responsive disease) but also is found in lead poisoning and in hypoglycemia that occurs in severe ketosis of cattle or in starving, chilled calves.

STUDY QUESTIONS

DIRECTIONS: Each of the numbered items or incomplete statements in this section is followed by answers or by completions of the statement. Select the ONE numbered answer or completion that is BEST in each case.

- Which one of the following statements regarding infectious bovine keratoconjunctivitis (IBK, "pinkeye") is true?
 - The causative organism, *Moraxella bovis*, is frequently spread from carrier animals in the herd by mosquitos (*Culicoides* species) or deer flies (*Tabanidae* species).
 - The causative organism, *Moraxella bovis*, uses pili to attach itself to the cornea and secretes a toxin that causes corneal lesions.
 - The clinical signs of IBK include tearing, photophobia, and blepharospasm, but there is seldom permanent ocular damage from this disease.
 - Preventive treatment is with long-acting penicillin to reduce the carrier state.
 - There are seldom adverse clinical effects, other than the ocular signs, associated with IBK.
- In regard to periodic ophthalmia of horses ["moon blindness," equine recurrent uveitis (ERU)], which one of the following statements best applies?
 - The ocular pain and tearing are usually associated with increased intraocular pressure.
 - A corneal ulcer is more likely if blepharospasm and corneal edema are present.
 - Infectious organisms (e.g., the microfilaria of *Onchocerca cervicalis*, *Leptospira* species) cause direct tissue damage, leading to ERU.
 - The treatment of this disease should include a broad-spectrum topical antibiotic and a cycloplegic, but corticosteroids are contraindicated.
 - Sequelae to repeated bouts of this uveitis can include anterior and posterior synechia, cataracts, cloudy vitreous, and butterfly lesions on the retina.
- Regarding ocular tumors in large animals, which one of the following statements is correct?
 - Ocular sarcoids in horses are locally invasive tumors caused by a virus similar to cattle papilloma virus; they are readily treated by cryotherapy.
 - Ocular squamous cell carcinomas (SCCs) appear almost exclusively in Hereford cattle and their crosses.
 - Periocular sarcoids appear to occur in young horses, with no breed, coat color or sex predilection, whereas ocular SCCs occur more commonly in older cattle that lack pigmentation around the eyes.
 - In cattle with an eye destroyed by SCC and an ongoing localized infection, the entire head and neck must be discarded before the carcass can be used for human consumption.
 - Immunotherapy with intralesional bacille Calmette-Guérin (BCG; attenuated *Mycobacterium bovis*) is the treatment of choice for ocular SCC in cattle.
- Which one of the following statements regarding ocular problems in large animal neonates is true?
 - Entropion in Hereford calves and in foals is most likely a congenital abnormality.
 - Entropion in lambs can affect many in a flock and can be successfully treated by application of a stitch or staple to evert the lower eyelid.
 - Microphthalmos in calves has been associated with intrauterine bovine viral diarrhea (BVD) infection, and in foals with midgestation equine herpes virus-1 (EHV-1) infection.
 - Dermoids in calves are most common in Holsteins; cryosurgery is required to prevent regrowth of the masses.
- Conjunctivitis is a common clinical sign in:
 - Equine viral arteritis, equine influenza, and equine herpes virus (EHV) infection in horses.
 - Moraxella bovis* infection in sheep and cattle.
 - Chlamydia psittaci* infection in sheep and *Moraxella equi* infection in horses.
 - Equine viral arteritis in horses and *Chlamydia psittaci* infection in sheep.
 - Mycoplasma agalactia* infection in goats and *Moraxella equi* infection in horses.
- In a horse with a corneal ulcer that is slow to respond to conventional treatment or suddenly worsens, which one of the following is an appropriate course of action?
 - Perform a corneal scraping for cytology and culture; mycotic keratitis is a high possibility.
 - Perform a corneal scraping for cytology and change to a broad-spectrum antibiotic; superinfection by a drug-resistant species of bacteria is likely occurring.
 - Create a third eyelid flap to facilitate blood supply to the ulcer.
 - Perform a corneal scraping for culture, and while waiting for the culture increase the frequency of drug administration to every second hour.
 - Create a third eyelid to deprive the invading organisms of oxygen.
- A 7-year-old Hereford cow has an ulcerated fleshy mass measuring 5 cm in diameter on the lower eyelid. The cow's eyes appear normal otherwise and she is in good body condition. Her vital signs are normal. What advice can you give the owner regarding treatment and the potential for salvage?
 - Surgical excision and immunotherapy with bacillus Calmette-Guérin (BCG, attenuated *Mycobacterium bovis*) is advisable; the cow will likely have its head and neck discarded if sent to slaughter.
 - The eye should be removed surgically and the cow will likely pass for slaughter, with condemnation of the head and tongue.
 - Surgical excision and cryotherapy is advised because the most likely tumor is only locally invasive and does not spread to lymph nodes.
 - Immunotherapy with BCG after surgical debulking is the preferred treatment because the cow will be condemned if sent to slaughter at this time.
- Which one of the following statements regarding entropion in large animal newborns is true?
 - In most cases, congenital entropion in foals should be surgically corrected because if untreated, corneal ulceration and neovascularization can occur.
 - Entropion in calves only occurs secondarily to profound dehydration and thus corrective surgery should not be performed.
 - Overzealous correction of entropion can lead to ectropion.
 - Treatment is by saline injection into the lower eyelid margin.

ANSWERS AND EXPLANATIONS

1. The answer is 2 [I B 21]. The organism responsible for infectious bovine **keratoconjunctivitis** (IBK, "pinkeye"), *Moraxella bovis*, has a pilliated phase, during which it is able to attach to the cornea, and a nonpilliated phase, during which it is apparently harmless. Once the organism has colonized the cornea, it secretes a bacterial cytotoxin that is responsible for initiating the corneal lesions. Untreated cases of pinkeye may result in corneal perforation and blindness. The ocular signs of this disease are certainly most prominent, but other adverse effects include decreased feed efficiency and milk production. *M. bovis* is spread from carrier cows to susceptible animals via the face fly (*Musca autumnalis*). Systemic penicillin is not an effective preventative treatment because it does not pass into lacrimal secretions in high enough concentrations.

2. The answer is 5 [III A]. Sequelae of periodic ophthalmia ("moon blindness," equine recurrent uveitis [ERU]) include anterior and posterior synechia, cataracts, cloudy vitreous, and butterfly lesions on the retina. Glaucoma (i.e., increased intraocular pressure) is rare in large animals and, in fact, there is most often decreased intraocular pressure in animals with ERU. Corneal ulceration is not a feature of ERU. Infectious organisms (e.g., *Leptospira* species or *Onchocerca cervicalis*) can cause this disease; however, they do not do so by direct invasion. Rather, disease occurs when dead or dying organisms cause antigenic stimulation, leading to inflammation and pain. Treatment of ERU includes corticosteroids (unless a concurrent corneal ulcer is present), nonsteroidal anti-inflammatory drugs (NSAIDs), and mydriatic cytoplegics. Topical antibiotics are of little value because the disease is immune-mediated, not infectious.

3. The answer is 3 [III A–B]. Equine periocular sarcoids are often seen in young horses, with no breed, coat color, or sex predilection, whereas ocular squamous cell carcinomas (SCCs) in cattle are seen most commonly in older cattle that lack pigmentation around the eyes. Although SCCs are over-represented in Hereford cattle, other breeds are also suscepti-

ble, including Holsteins and Simmentals. Ocular sarcoids in horses are difficult to treat and many methods, including radiotherapy, cryotherapy, and chemotherapy, are met with very limited success. An animal with an eye destroyed by SCC and with an ongoing localized infection is unfit for human consumption and must be condemned. **Bacille Calmette-Guérin** (BCG, attenuated *Mycobacterium bovis*) is the treatment of choice for periocular sarcoids in horses, not SCC in cattle. In cattle with SCC, surgical treatments are the most effective.

4. The answer is 2 [III C]. Entropion, a common congenital condition in lambs, is not so common in foals and calves. In lambs, the majority of the flock can be affected. Treatment entails eyelid eversion, using either a simple stitch or staple. Microphthalmos, while induced by infection with the bovine viral diarrhea (BVD) virus in calves, is regarded as idiopathic or genetic with no association with equine herpes virus-1 (EHV-1) infection in foals. Dermoids are most common in the Hereford breed, not the Holstein breed.

5. The answer is 4 [IV C 2]. Conjunctivitis is often a clinical sign of equine viral arteritis in horses and Chlamydia *psittaci* infection in sheep. Equine influenza virus, equine herpes virus, *Moraxella bovis*, *Moraxella equi*, and *Mycoplasma agalactia* infection are not associated with conjunctivitis.

6. The answer is 1 [I A 4 a (1) (b)]. With corneal ulcers that are slow to respond or resistant to treatment, a secondary **mycotic keratitis** is a distinct and the most likely possibility. Therefore, a corneal scraping for cytology and culture should be performed, and the administration of antifungal drugs may be appropriate pending the results. Any treatment that increases the dose of antibiotic or closes the eye can potentiate fungal growth.

7. The answer is 2 [III B 3 c 4]. **Squamous cell carcinoma** (SCC) is the most likely diagnosis. The ocular and periocular involvement is minimal; therefore, in all likelihood, the cow

would not be condemned (exclusive of the head and tongue) if sent to slaughter. The treatment of choice in this case is surgical excision of the eye. The description of the case does not indicate spread to other tissues, but the ocular SCC can metastasize to the lymph nodes. Intralesional instillation of bacille Calmette-Guérin (BCG; attenuated *Mycobacterium bovis*) has not proven useful in the treatment of SCC.

8. The answer is 3 [III C]. Overzealous correction of entropion will result in permanent eversion of the lower eyelid (ectropion). Entropion is not recognized as a congenital problem in foals, but is seen as a congenital problem in lambs and Hereford calves. Injection of a bleb of procaine penicillin will serve as satisfactory treatment for entropion, but saline is too rapidly absorbed to be effective.